

CASE STUDY

Argonne National Laboratory Puts Alternative-Fuel Vehicles To The Test



Argonne National Laboratory supports alternative-fuel vehicles both in theory and in practice. As its scientists study new ways to power cars and trucks, Argonne's fleet is participating in a program to evaluate the performance, operation, and cost of a variety of alternative-fuel vehicles.

AFVs are Integral Part of Fleet

Located near Chicago, Argonne is one of the U.S. Department of Energy's (DOE's) largest research and development centers. The 1,700-acre site comprises more than 60 buildings linked together by almost 40 miles of road. Its 4,500 scientists, engineers, and support staff perform research in (a) engineering; (b) basic sciences; and (c) energy, environmental, and biomedical sciences. The Technology Engineering Group is involved in testing alternative-fuel vehicles (AFVs), encouraging the design of AFVs, and developing cleaner-burning engines. To support these activities, Argonne maintains a fleet of 300 vehicles, including AFVs. Because of its role in automotive engineering research and experience in fleet management, Argonne was an ideal candidate for programs conducted under the Alternative Motor Fuel Act (AMFA) of 1988.

The Alternative Motor Fuel Act directs DOE to purchase original equipment manufacturer (OEM) AFVs; use them in the federal fleet; and collect data on their performance, fuel economy, and durability. Managed by DOE's National Renewable Energy Laboratory (NREL), this demonstration project analyzes fuel economy, performance, safety, maintenance, emissions, and costs of AFVs. The resulting information is available to the public as well as researchers.

Argonne's Center for Transportation Research maintains the largest demonstration center in the AMFA Program. Data collection focuses on vehicle driveability, reliability, and fuel efficiency, but other operational characteristics are also monitored, such as emissions and performance



under varying weather conditions. The Laboratory became involved in 1992 when it leased five compressed natural gas (CNG) vans and three ethanol sedans. Today, Argonne operates 62 alternative-fueled sedans, vans, minivans, and pickup trucks under the program. Seven gasoline-fueled vehicles are used as control vehicles for comparison studies.

The AFVs are an integral part of Argonne's fleet. Employees use the AFVs in their daily work, including material pickup and delivery, maintenance activities, field supervision, equipment installation, mail delivery, security, ambulance/rescue/fire, off-road/road repair, chauffeuring guests, and driving to meetings. They can be used only for official business, but they may be taken overnight for business trips. The experience gained from this real-life fleet operation at Argonne is documented in the AMFA Program.

Leasing AFVs from the General Services Administration

Argonne leases vehicles through the General Services Administration (GSA), which purchases all the vehicles for the federal fleet. Argonne tries to obtain at least one example of each type of OEM light-duty AFV available from GSA. New vehicles are put into service as soon as they become available.

Although AFVs can cost more than gasoline-powered versions (CNG vehicles may be as much as 25% higher), the GSA reduces the monthly leasing cost for AFVs by 10% when operators primarily use alternative fuel. Argonne reports fuel usage to GSA on a monthly basis. The GSA usually retires sedans after three years of service and vans or trucks after seven years. Replacement AFVs are purchased each year as budget and availability allow.

On-Site Fueling

Because there are no commercial alternative-fuel stations nearby, Argonne maintains its own refueling stations. The vans are dedicated CNG, the pickups are bi-fuel, and the sedans are flexible-fuel. The sedans can run on either alternative fuel or gasoline; they use alternative fuel 84% of the time. When they are off-site, however, the sedans are refueled with gasoline.

Existing Methanol Facility Continues Operation

Argonne had built a methanol (M85) fueling station in 1989 under DOE's Federal Methanol Fleet Demonstration Program. The Laboratory served as the official cold weather test site for this earlier program, which gathered field data on dedicated methanol vehicles. The methanol refueling facility, now used for the AMFA Program, includes a 10,000-gallon underground storage tank. The tank,

pump, and piping are made of special methanol-compatible materials.

The Laboratory also needed an air quality permit from the Illinois Environmental Protection Agency. The Chicago metropolitan area, in which Argonne is located, is designated as a severe non-attainment area for ozone, and volatile organic compound emissions must be minimized. A special nozzle, similar to that required for gasoline, was installed to meet state requirements.

Meeting Environmental Requirements for an Ethanol Refueling Facility

Argonne also built its own ethanol (E85) station. Installation of a 1,000-gallon tank began in October 1992. Ethanol-compatible materials were used for the tank, pump, and piping. The tank could not be filled until the Laboratory received an air quality permit from the Illinois Environmental Protection Agency. Special nozzles, like the ones used for methanol and gasoline, were installed, but special vents were also needed because the tank is above-ground. The station met Stage I vapor recovery system requirements and became operational in March 1993. In October 1994, the tank was upgraded to meet Stage II requirements.

Compressed Natural Gas Presents Challenges

The cooperation of Northern Illinois Gas (NIGas), the local utility company, has been a vital factor in setting up Argonne's CNG refueling facilities. The company has loaned various pieces of equipment to the Laboratory, free of charge, in support of the AFVs. NIGas also provides maintenance services for the equipment.

In October 1992, NIGas loaned Argonne a temporary portable quick-fill CNG

Fleet Facts

Fleet Type: Federal government

Fleet Size: 62 AFVs in a 300-vehicle fleet

Alternative Fuels: CNG, E85, M85, and propane

Vehicles: OEM sedans, pickups, vans, and minivans

Location: Argonne, Illinois, near Chicago

Argonne's Total Vehicle Fleet

Type of Vehicle	Quantity	Miles per Week (average per vehicle)
Compact cars	14	101
Mid-size sedans	47	70
Full-size sedans	1	104
Police cars	8	144
Minivans	9	90
Full-size vans	36	62
Compact pickup trucks	23	68
Full-size pickup trucks	50	60
Sport utility vehicles	25	28
Heavy-duty/ special-use vehicles	87	573

refueling trailer with a 24-cylinder cascade. By March 1993, the cascade was being exchanged twice a week instead of only once.

In mid-December 1994, NIGas replaced the portable refueling trailer with a self-contained Hurricane CNG compressor and a cascade. Required safety precautions for this new temporary refueling



facility included barricades, fire extinguishers, and an emergency shut-off button. Members of Argonne's Technology Engineering Group gave drivers a station overview and safety explanation.

In May 1996, NIGas moved the Hurricane CNG compressor to the Olympics in Atlanta. Two FuelMakers replaced the compressor. These portable gas-powered units compress natural gas and dispense it into fuel tanks. Each self-contained outdoor appliance can fill a 26.4-gallon cylinder to a pressure of 3,000 psig at 68°F within 8 hours. Drivers follow a strict refueling schedule because of the limited fuel supply. It takes about 4 hours to compress enough natural gas to fill one vehicle, and vehicles are allowed only one refueling per week. Argonne has submitted a proposal for a permanent CNG refueling facility to meet current demand and allow for future growth of the CNG fleet.

Maintaining AFVs On Site

Argonne's Vehicle Maintenance Group performs all routine maintenance on the AFVs. A Cross-Service Agreement between the DOE and GSA sets the reimbursement rates and procedures for fuel and maintenance on AFVs. The GSA provides a monthly listing of AFVs that need

preventive maintenance along with specific instructions for each vehicle.

By performing preventive maintenance on site, Argonne mechanics have unique opportunities for professional development. Although not required by the Laboratory, most Argonne mechanics are trained and certified to work on CNG vehicles through the National Institute for Automotive Service Excellence. On-site maintenance also permits better tracking of the field use of the AFVs and more accurate and detailed data on maintenance and repair of AFVs, which is needed for the AMFA Program.

Relatively minor design changes turn a gasoline-fueled car into an AFV fueled by E85 or M85, but a CNG vehicle needs more extensive modifications because of its gaseous fuel. Earl Powell, Vehicle Maintenance Supervisor, says that his mechanics have experienced few differences in servicing gasoline vehicles and AFVs. However, they do follow more stringent safety procedures because M85 and E85 are more corrosive than gasoline. The AFVs also require special, more expensive motor oil; they need oil changes about every two to eight months, depending on model and mileage accumulated.

Driver Acceptance and Vehicle Performance

The Vehicle Maintenance Group assigns the AFVs according to need. Drivers receive an overview of the AMFA Program and instructions on vehicle operation and refueling. They keep trip logs, and their comments on the vehicles are collected and analyzed for the AMFA Program. Reactions have been very positive. Powell says that many drivers feel they are participating in an important study that will result in future benefits to both the Laboratory and the nation.

When the AFVs first arrived at Argonne, a representative from NREL led an orientation session that instructed drivers on the unique characteristics and operating procedures of CNG vehicles. General Motors Corporation also provided training on the Chevrolet Lumina. All members of Argonne's Fire Department also attended a course in AFVs so that they could understand the hazards of alternative fuels and how to handle them safely.

Argonne drivers have found that AFVs perform similarly to conventional vehicles in terms of safety, handling, acceleration, and power. Out of a total of 31,745 days on the road, AFV drivers registered complaints on only 420 days (1%), while drivers of gasoline vehicles registered no complaints. The AFVs in Argonne's fleet do break down more frequently than conventional vehicles, however; and Argonne's CNG vehicles break down more often than the ethanol and methanol vehicles do. The problems reported include hesitation, difficulty starting, poor idle quality, lack of power, pinging, and stalling. Most of these service requests relate to the fuel system, such as problems with the fuel pressure regulators, check valves, and fuel gauges.

The vehicles are returned to local car dealers for repairs that are covered under warranty. Argonne has experienced difficulties in finding dealerships willing to work on AFVs, and those that are willing may not be fully qualified. Two AFVs were returned to GSA after repeated unsuccessful attempts by the dealer to correct problems.

Looking to the Future

Argonne's first propane-fueled vehicle arrived in 1996. The bi-fuel propane/gasoline pickup truck is currently operated mainly on gasoline. The Laboratory

does not currently have a propane refueling station, and the nearest commercial propane refueling station is 18 miles away. Plans are in place for installing a propane fueling facility on site in the near future.

Older models will be replaced; however, there are no current plans to expand the fleet. The addition of electric-powered Chevrolet S-10 pickup trucks is being considered, and Commonwealth Edison, the local electric utility, has offered help in setting up a recharging facility.

BY THE NUMBERS

GSA Mileage Fee: (same as for conventional vehicles)	CNG van: \$0.165
	CNG Caravan: \$0.145
	AFV sedans: \$0.105
Fuel Cost:	Methanol: \$1.29/GGE*
	Ethanol: \$0.89/GGE*
	(donated for first 2 years of program) Gasoline: \$0.72/gallon
Oil Cost:	Ford AFVs: \$6.01/qt
	Other AFVs: \$0.85/qt
Mileage:	M85 sedans: 19 mpg
	E85 sedans: 19.6 mpg
	Gasoline sedans: 17.1 mpg

*GGE: Gasoline Gallon Equivalent

Argonne expects to continue its participation in the AMFA Program. According to Earl Powell, the experience of both drivers and maintenance personnel has been overwhelmingly positive. He hopes the information gathered about the daily operation of AFVs under real-life conditions will help not only federal agencies that need to purchase such vehicles, but also other organizations and even individuals who plan to use them and the automakers that will design and manufacture them.

For more information on Argonne's experience with AFVs, contact:

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Argonne's AMFA Program Vehicles

Fuel	Type	Quantity	Purchase Cost	Miles per Week (average per vehicle)
CNG	Dodge B250 Van	8	1994: \$17,740	83
	Dodge Caravan	4	1994: \$20,607	68
	Ford F150 Pickup	5	1996: \$19,162	411
	Ford F250 Pickup	4	1996: \$19,162	582
Methanol	Dodge Spirit	11	1994: \$13,310	52
	Chevrolet Lumina	3	1993: \$10,245	65
	Dodge Intrepid	3	1995: \$16,321	83
Ethanol	Chevrolet Lumina	3	1992: \$14,822	99
	Ford Taurus	13	1996: \$15,044	61
			1995: \$14,781	
Propane	Ford F150 Pickup	1	1996: \$16,889	20
Gasoline	Chevrolet Lumina	1	1993: \$10,559	28
	Dodge Intrepid	3	1995: \$16,232	59
	Ford Taurus	3	1995: \$13,960	100

Ethanol Refueling Guidebook Available

A *Guidebook for Handling, Storing, and Dispensing Fuel Ethanol* has been published by the U.S. Department of Energy's Argonne National Laboratory. Subjects covered include fuel specifications, fuel handling, equipment recommendations, safety practices, and testing procedures. A copy of the document can be obtained through the National Alternative Fuels Hotline (800/423-1363).

Disclaimer

This case study is intended only to illustrate approaches that organizations could use in adopting AFVs in their fleets. The data cited here, although real experience for the fleet discussed in this case study, may not be replicated for other fleets. For more comprehensive information on the performance of AFVs and other related topics, please call (800/423-1363) or e-mail (hotline@afdc.nrel.gov) the National Alternative Fuels Hotline. To learn more about DOE's role in alternative-fuel vehicle research, visit the Alternative Fuels Data Center on the World Wide Web at <http://www.afdc.doe.gov>.

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